



# Comparison among different decommissioning funds methodologies for nuclear installations

**Final Report**

## Country Report Belgium

on behalf of the European Commission  
Directorate-General Energy and Transport, H2

Service Contract TREN/05/NUCL/S07.55436

Wuppertal, 2007

**Editor:**

Wuppertal Institut für Klima, Umwelt, Energie GmbH  
im Wissenschaftszentrum Nordrhein-Westfalen



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**Comparison among different decommissioning funds  
methodologies for nuclear installations**

**Final Country Report (WP 1/WP 3)**

**Belgium**

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Paris, 31 October 2006

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## Summary

Belgium has set up a heterogeneous system for cost assessment and financing of nuclear decommissioning and waste management. The cost assessment for decommissioning is partly done by external engineering companies whose reports are not publicly available. The cost evaluation for spent fuel and radioactive waste management, remain highly speculative in the absence of any final disposal site.

There are several funding schemes:

In the case of the seven **nuclear power plants**, the nuclear fuel company SYNATOM, a subsidiary of ELECTRABEL, is responsible for establishing and managing nuclear provisions on behalf of ELECTRABEL and SPE (Public Electricity Society). The provisions are subject to discounting calculated on a maximum commercial operating lifetime of 40 years. The discount level applied is 3% per year (5% discount rate and 2% inflation, as is French practice).

In the case of the so-called **nuclear liability programmes**, which include the shut-down reprocessing plant EUROCHEMIC and waste conditioning facilities in Mol, the Belgian State is responsible to collect the necessary funds via a levy on the distributed kWh that the distributor has the right to pass on to the final electricity customer. But it is the national waste management company ONDRAF/NIRAS that holds and manages the fund.

In the case of all **other facilities**, it is the owner or operator who holds the funds.

ONDRAF/NIRAS has identified a number of weaknesses in the system “that could put into jeopardy the availability and the sufficiency of the financial provisions accumulated”, which need “corrective measures”. These include:

- The Identification of the financial responsibilities for certain sites is difficult. Who is financially responsible for the site, the operator, the owner of the facilities, the owner of the site hosting the facilities, the tenant of the facilities or someone defined as responsible within a contract that links the parties?
- The determination of the existence or the lack of provisions of organisations that are not submitted to accountancy obligations (the Belgian state, universities...) can turn out difficult.
- The financial means underlying the accounting provisions are generally re-injected into the operation of the companies, which, considering the economic uncertainties, can jeopardise their availability in the long term.
- The coverage of the nuclear costs by a financial mechanism suggests the upholding of this mechanism for the entire operating period of the corresponding facilities as initially planned. The risk of premature closure of the facilities or other disruptions raise the question of the backup financial mechanisms.
- The cost calculations are surrounded by uncertainties that are only partially covered by a margin that is included in the calculation of the provisions. Once this reserve is

exhausted, the state will be the only financial guarantor of the long term financing of the safe disposal of radioactive substances.

- According to a number of financial officials the lack of fiscal deductibility of nuclear provisions, with the exception of those set up for the nuclear power plants, constitutes a restraint for their constitution.

From the available information one concludes, that the successful application of the polluter-pays principle on the nuclear backend costs does not seem to be guaranteed yet in Belgium. Large uncertainties remain, in particular on the cost assessment for final disposal of radioactive wastes. A significant problem is the lack of access to information.<sup>1</sup> All underlying reports on facility specific cost calculation remain confidential and even the reports of the governmental Surveillance Committee that monitors organisation and management of backend provisions are not publicly accessible.

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<sup>1</sup> With the noteworthy exception of Belgoprocess, operators in Belgium that have been submitted a questionnaire by the author did not respond.

# 1 Introduction and overview

There are currently seven operating nuclear power plants in Belgium. The law of 31 January 2003 on progressive phase-out of nuclear industrial electricity production<sup>2</sup> prohibits the construction of new nuclear power plants and limits the operation of existing nuclear power plants to 40 years after commercial start-up. The first reactors started commercial operation in 1975, and no decommissioning activity is foreseen before 2015.

It is remarkable to note that the new government that was elected in 2003, after the Green-Red coalition that had adopted the nuclear phase out policy, did not embark on a rollback strategy of the objective to abandon nuclear power in the country.

In the context of the liberalisation of the European electricity market, and in the new legal framework set by the Law on nuclear phase-out, Belgium adopted in April 2003, a new law on the provisions for the dismantling of nuclear power plants and the management of spent fissile materials<sup>3</sup>, modifying the way dismantling funds are set aside. This law aims to increase state control in order to make sure that the necessary funds will be available for the dismantling of nuclear power plants and the management of spent fuel. It also aims to allow operators to continue to use, to a certain extent, the important sums of money set aside as funds for this purpose.<sup>4</sup>

Belgium embarked early after the Second World War on a full-scale nuclear program, including research reactors, then commercial light water reactors and the plutonium fuel cycle with reprocessing and a plutonium fuel fabrication plant. Belgium had stakes in the fast breeder reactor projects SNR-300 in Kalkar, Germany (abandoned) and Superphénix in Creys-Malville, France (shut-down) and in the uranium enrichment consortium EURODIF, France.

The main actors of the nuclear program in Belgium are the utility ELECTRABEL<sup>5</sup> and its subsidiary SYNATOM<sup>6</sup>, the fuel companies FBFC<sup>7</sup> and BELGONUCLÉAIRE as well as the national radioactive waste management agency ONDRAF/NIRAS and its subsidiary BELGOPROCESS<sup>8</sup>. The SCK/CEN is the main nuclear research and waste management centre in Belgium.

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<sup>2</sup> Loi sur la sortie progressive de l'énergie nucléaire à des fins de production industrielle d'électricité, 31 janvier 2003, [http://www.juridat.be/cgi\\_loi/loi\\_a.pl?language=fr&caller=list&cn=2003013138&la=f&fromtab=loi&sql=dt='loi'&tri=dd+as+rank&rech=1&numero=1](http://www.juridat.be/cgi_loi/loi_a.pl?language=fr&caller=list&cn=2003013138&la=f&fromtab=loi&sql=dt='loi'&tri=dd+as+rank&rech=1&numero=1)

<sup>3</sup> Loi du 11 avril 2003 sur les provisions constituées pour le démantèlement des centrales nucléaires et pour la gestion des matières fissiles irradiées dans ces centrales, Moniteur Belge 15/07/2003 [http://www.ejustice.just.fgov.be/mopdf/2003/07/15\\_1.pdf](http://www.ejustice.just.fgov.be/mopdf/2003/07/15_1.pdf)

<sup>4</sup> NEA, Nuclear Law Bulletin No. 73, 2004

<sup>5</sup> As of the end of 2005 SUEZ held 98.62% of the ELECTRABEL shares.

<sup>6</sup> 100% ELECTRABEL, golden share held by the Belgian state

<sup>7</sup> 100% AREVA

<sup>8</sup> 100% ONDRAF/NIRAS

The takeover of ELECTRABEL, which operates all seven nuclear power plants in Belgium, by the French company SUEZ has raised a number of concerns. Not only that this is the first time that a private company takes over the entire nuclear generation capacity in another country – nuclear power provides over 50% of the electricity in Belgium – but also the potential consequences for decommissioning and waste management liabilities have raised concerns, including in the Belgian Parliament.<sup>9</sup> The fusion project of the French state owned Gaz de France (GDF) with SUEZ<sup>10</sup> adds to the concerns because it would mean that de facto the French state would gain control over Belgian nuclear power plants and decommissioning funds.

### The status of the nuclear installations in Belgium

Besides the seven light water reactors that are operated at the two sites Tihange and Doel, there are two fuel fabrication plants (the FBFC plant and Belgonucléaire's MOX plant) in Dessel.

The Eurochemic reprocessing plant, also located in Dessel, was constructed from 1960 to 1966. A consortium of 13 OECD countries operated this demonstration plant from 1966 to 1974, and reprocessed 180 tons of natural and low enriched and 30 tons of high enriched uranium fuels. After shutdown, the plant was decontaminated from 1975 to 1979 to keep it in safe standby conditions at reasonable cost. In 1984, Belgoprocess took over the activities on site. When it was decided in 1986 not to resume reprocessing in Belgium, the main Belgoprocess activities changed to processing and storage of radioactive waste and to decontamination and decommissioning of obsolete nuclear facilities.

The main decommissioning activities so far relate to

- the **BR3** reactor of SCK•CEN: the reactor and its building should be completely dismantled in 2009 and serves as a pilot project for this activity;
- the **EUROCHEMIC** spent fuel reprocessing pilot plant, which should be dismantled in 2007;
- the former **SCK•CEN Waste department** (site 2 of Belgoprocess), where decommissioning started in 1998 and should end in 2020.
- In addition, some buildings of the SCK•CEN, namely those transferred to **VITO** (Vlaams Instituut voor Technologisch Onderzoek) due to the splitting in 1991, were decontaminated and decommissioned.

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<sup>9</sup> see draft legislative bill introduced by Gerkens et al: *Proposition de loi sur les provisions constituées pour le démantèlement des centrales nucléaires et pour la gestion de matières fissiles irradiées dans ces centrales*  
(<http://www.dekamer.be/kvvcr/showpage.cfm?section=flwb&language=fr&rightmenu=right&cfm=flwbn.cfm?lang=N&legislat=51&dossierID=2462>)

<sup>10</sup> According to the company's 2005 Reference Document, the public holds 75.9% of the shares with no shareholder with more than 5% ; the largest identified private shareholder is the Groupe Bruxelles Lambert (GBL) with 7.3%



The most significant facilities from a decommissioning point of view are the large plutonium bulk-handling facilities at Dessel, the Eurochemic reprocessing plant and the Belgonucléaire MOX fuel fabrication plant. Plutonium is a powerful alpha emitter that is highly radiotoxic and difficult to monitor. Microgram quantities incorporated in the human body, particularly in the lungs, can provoke cancer. Large plutonium plants process several metric tons of plutonium every year. A single facility can cumulate kilogram quantities stuck to inner walls of tubes, machine parts, containers, glove boxes.

The decommissioning of the Eurochemic plant will provide important information for further dismantling activities. This will be particularly valuable for the decommissioning of the MOX fuel fabrication plant that shall cease operation in the course of 2006.

Table 1 Overview on nuclear installations in Belgium to be analysed

Nuclear facility	Short name	Country	Kind of facility: NPP = nuclear power plant	Output (Power in MW <sub>el</sub> for NPP)	Operational period	Operating company	Decom. started in year	Decommissioning stage*	WP 1	source
Dessel-Belgonucléaire	P0	BE	Fuel Fabrication (MOX)	Capacity: 40 tHM/y Prod: 38 tHM/y	Industrial Production : 1986 (4) - 2006	Belgonucléaire			x	(1) (4)
Dessel-FBFC		BE	Fuel Fabrication	Capacity: 400 tHM/y		FBFC			x	(1)
Eurochemic	BP1	BE	Reprocessing	100 thM/y	1966 - 1974	Eurochemic(e)	1990 (d)	Should be dismantled by 2007	x	(1) (3)
Pamela	BP2	BE	Waste conditioning		1985 - 1991	Belgoprocess			x	(2)
BR3 - Mol	BR3	BE	Research Reactor			SCK-CEN		Under decom (should be completely dismantled by 2009)	x	(2)
Doel-1		BE	NPP	392/412	1975 -	ELECTRABEL			x	(5)

**Notes pertaining to Table 1:**

- (a) NEI : Ownership : Société de Prayon Rupe 100%, All production allocated to SYNATOM
- (b) ONDRAF/NIRAS has subcontracted the industrial aspects of the management to its 100% subsidiary company, Belgoprocess. In that respect, Belgoprocess operates in Mol and Dessel radioactive waste processing & conditioning and storage installations. (2)
- (c) See precision in (2)
- (d) The industrial decommissioning of the main process building of the former Eurochemic reprocessing plant was started in 1990 (3)
- (e) The Eurochemic reprocessing facility at Dessel was constructed from 1960 to 1966. It reprocessed in total 181.5 tons of natural and low-enriched and 30.6 tons of high-enriched uranium fuels. After shutdown, the plant was decontaminated from 1975 to 1979 to keep it in safe standby conditions at reasonable cost. In 1984, Belgoprocess took over the activities on site. (3)
- (f) See [http://www.nirond.be/engels/7.4\\_Opslag\\_eng.html](http://www.nirond.be/engels/7.4_Opslag_eng.html)

**Sources :**

- (1) NEI – World Nuclear Industry Handbook – 2004
- (2) Second meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management - May 2006 - National Report – Kingdom of Belgium
- (3) Belgoprocess - The Decommissioning of the Eurochemic Reprocessing Plant
- (4) Belgonucléaire - <http://www.belgonucleaire.be/uk/aboutus.htm>
- (5) IAEA – PRIS Database

## 2 Decommissioning strategies and costs

### 2.1 Current and past decommissioning activities

The decommissioning strategies are facility specific and can differ from one facility to another. The nuclear power plant operator did not yet define a decommissioning strategy. In fact, no final shutdown of a nuclear power plant is currently planned before the year 2015. Nevertheless, cost evaluations and financial provisions are based on the immediate dismantling of the plants, because this approach is considered more conservative as far as funding aspects are concerned.

The immediate dismantling is the selected strategy for the ongoing decommissioning of the so-called "nuclear liability programmes", mainly owing to the fact that financial means were provided by the Belgian government and the electricity producers. A deferred decommissioning strategy was also considered by the government to be "unacceptable to the public" [MINECO 2005]. Nevertheless, technical and safety reasons also contributed to the choice:

- The delay of decommissioning of the EUROCHEMIC reprocessing plant presented no interest from the point of view of radioactive decay due to the presence of plutonium contamination. It would also lead to higher costs because of extended stand-by cost expenditures.
- The former waste treatment department of SCK•CEN needed immediate measures for safety reasons and presented some  $\alpha$ -contamination.
- The BR3 research reactor was selected in 1989 by the European Commission as one of the pilot projects for decommissioning with financial contribution from the Commission. It was to demonstrate decommissioning feasibility in particular of the nuclear island. Furthermore, decommissioning cost estimates were carried out for different strategies, which indicated that immediate decommissioning was favourable. [MINECO 2005]

Until 2002 financial means for these "nuclear liability programmes" were provided by the Belgian government and the electricity producers on the basis of annual endowments. From 2003 onwards the dismantling of the EUROCHEMIC plant and the former waste management site of SCK-CEN is financed by a levy on the electricity consumption. The old facilities of the SCK-CEN are still financed by the Government.

In general decommissioning is aimed at "green field" (level 3) conditions. However, it is left open that the destination of the site might be changed even as late as during the decommissioning work and it could be decided to reuse the site or some buildings for other purposes. This is currently under consideration in the case of the BR3 research reactor. In the case of the fuel fabrication plants FBFC and Belgonucléaire, the decommissioning objective is the decontamination of the buildings for eventual conventional reuse.

## 2.2 The Licensing Procedures

The operators of the major nuclear facilities have to request a decommissioning license, which defines the objectives of the decommissioning programme. The application for a decommissioning license, introduced by the operator to the Federal Agency for Nuclear Control (FANC), has to contain general information, the objectives to deal with and the appropriate destination of the radioactive substances, and a preliminary safety report. For specific installations, an Environmental Impact Assessment report has to be included. The application for decommissioning has to include an opinion by ONDRAF/NIRAS on all matters belonging to its responsibilities.

A 1981 Royal Decree, modified in 1991<sup>11</sup>, in article 3 defines the relationship between the radioactive waste producer and ONDRAF/NIRAS. The producer is obliged to transmit to ONDRAF/NIRAS on request any information estimated necessary to fulfil its duties and in particular to establish the inventory of radioactive wastes stemming from operation and decommissioning of nuclear facilities. ONDRAF/NIRAS signs a convention with the operator, which defines rights and obligations of both parties. The waste producer is requested to:

- continuously update and verify the inventory of radioactive wastes stemming from operation and decommissioning of nuclear facilities;
- have appropriate financing in order to carry out the programme.

The convention shall also define the transfer of responsibilities and the financial and technical conditions. ONDRAF/NIRAS's board annually fixes the commercial conditions applicable to each waste category that is not part of the general convention. ONDRAF/NIRAS notifies the discharge of responsibility once it has received the waste. The conventions contain a clause that keeps liable the entity that has conditioned the waste for up to 50 years for eventual defects leading to unexpected expenditures for reconditioning or additional storage costs.

A similar convention is signed between ONDRAF/NIRAS and an organisation that detains enriched fissile or plutonium bearing materials and wishes to transfer it to ONDRAF/NIRAS.

Every operator that wishes to dismantle a nuclear facility shall transmit at the latest three years before the closure of the facility all information concerning the nature, the quantity and the dates of transfer of wastes to be transmitted to ONDRAF/NIRAS as well as any information about potential long term financial implications.

The decree also envisages the situation where a nuclear operator wishes to be disengaged of the decommissioning operations and allows for the signature of a

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<sup>11</sup> Royal Decree dated 30 March 1981 *déterminant les missions et fixant les modalités de fonctionnement de l'organisme public de gestion des déchets radioactifs et des matières fissiles*; modified by Royal Decree dated 16 October 1991, [http://www.juridat.be/cgi\\_loi/loi\\_F.pl?cn=1981033001](http://www.juridat.be/cgi_loi/loi_F.pl?cn=1981033001)

convention with such operator that leads to the transfer of responsibilities to ONDRAF/NIRAS.

The legal basis regulating the responsibilities for the dismantling of the nuclear power plants and the back-end of the nuclear fuel cycle is the law of 11 April 2003.

According to this law, SYNATOM is responsible for establishing nuclear provisions on behalf of ELECTRABEL and SPE (Public Electricity Society).

The law provides in particular for

- the creation of a Surveillance Committee (Comité de suivi) and its responsibilities;
- the development of a new methodology for the calculation of nuclear provisions;
- the transfer of existing provisions from ELECTRABEL/SPE to SYNATOM;
- the percentage of the provisions that can be lent to ELECTRABEL and SPE;
- the management mode of the funds.

The Surveillance Committee consists of:

- The General Administrator of the Treasury;
- The President of the Board of the Electricity and Gas Regulation Commission;
- The President of the Insurances Control Office;
- The senior civil servant of the Budget Administration;
- A representative of the National Bank of Belgium;
- The senior civil servant of the Energy Administration;

The members of the Surveillance Committee and their respective substitutes are nominated by Royal Decree after decision by the Council of Ministers.

The Surveillance Committee gives an advice on the method used for the constitution of provisions for decommissioning activities and periodically assesses the appropriateness of those methods (article 5.1). It controls data provided by the provision company SYNATOM regarding sufficiency of provisions, correct application of methods to constitute decommissioning provision and lending conditions to nuclear operators (article 5.2).

Every three years, the Surveillance Committee carries out an audit of the methods used to constitute provisions for decommissioning and fissile materials management (article 12).

For nuclear facilities other than nuclear power plants, there is no specific legal obligation for the operators to constitute provisions for future liabilities apart from the general obligation of the book-keeping regulation to foresee the necessary provisions for future liabilities. However, the following general regulations exist:

- The Royal Decree of 1981, modified in 1991, regulating ONDRAF/NIRAS<sup>12</sup> specifies that ONDRAF/NIRAS has to determine with the operators the financing conditions for the decommissioning and the management of the resulting wastes;
- The law of 12 December 1997<sup>13</sup> defines ONDRAF/NIRAS's mission to establish an inventory of all nuclear facilities and all sites containing radioactive substances. This inventory includes the estimate of the respective decommissioning costs, the assessment of the abundance and security of the provisions for the financing of decommissioning. The inventory has to be sent to the competent minister, who can oblige the operator or owner to take corrective measures. [MINECO 2005] The first ONDRAF/NIRAS inventory, covering the period 1998-2002, was completed in January 2003, but the document was not released to the public.<sup>14</sup>

The conditions that need to be met to be able to de-licence a site are defined in general terms in the Royal Decree of 20 July 2001. It shall be possible to withdraw the nuclear facility from the list of classified installations as defined in terms of the dispositions of the Royal Decree and remove all nuclear regulatory restrictions and controls. In practice, this means that all radioactivity has to be removed from a nuclear facility or site, not only from the buildings, which require to be decontaminated, but also from the soil that also needs to be cleared from contamination. The removal or the absence of contamination has to be proven by appropriate measurements, the results of which have to be approved by the safety authorities (FANC). Once the safety authorities have released the site unconditionally, this means that the owner or operator has been discharged of any further responsibility for the site. Any potential discovery of radioactivity onsite will normally not give rise to liability for the owner or operator. [MINECO 2005]

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<sup>12</sup> Arrêté royal du 30 mars 1981 déterminant les missions et fixant les modalités de fonctionnement de l'organisme public de gestion des déchets radioactifs et des matières fissiles [http://www.juridat.be/cgi\\_loi/loi\\_F.pl?cn=1981033001](http://www.juridat.be/cgi_loi/loi_F.pl?cn=1981033001) and

Arrêté royal du 16 octobre 1991 fixant les règles relatives au contrôle et au mode de subvention de l'Institut national des Radioéléments, et modifiant les statuts de cet institut [http://www.juridat.be/cgi\\_loi/loi\\_F.pl?cn=1991101635](http://www.juridat.be/cgi_loi/loi_F.pl?cn=1991101635)

<sup>13</sup> Loi-programme du 12 décembre 1997 portant sur des dispositions diverses, Moniteur Belge, 18/12/97 (article 9) [http://www.ejustice.just.fgov.be/mopdf/1997/12/18\\_1.pdf](http://www.ejustice.just.fgov.be/mopdf/1997/12/18_1.pdf)

<sup>14</sup> See ONDRAF/NIRAS « Inventory of Nuclear Liabilities », [http://www.nirond.be/engels/7.8\\_Inventaris\\_eng.html#liabilities](http://www.nirond.be/engels/7.8_Inventaris_eng.html#liabilities); ONDRAF/NIRAS, when refusing the publication of the inventory, refers to the law of 11 December 1998 transposing to Belgian legislation EU Directive 95/46/CE of 24 October 1995. However, it is unclear which article it refers to.

## 2.3 The decommissioning status of specific facilities<sup>15</sup>

### **EUROCHEMIC (BP1)**

The execution of extensive decommissioning activities started in 1987 with the preparatory work for the former EUROCHEMIC reprocessing plant. The plant was jointly operated by a consortium of 13 European countries, but after its final shutdown, only the Belgian State remained responsible for the execution of the decommissioning programme and the largest part of its financing. The waste management and decommissioning company BELGOPROCESS, a subsidiary of the National Agency for Radioactive Waste and enriched Fissile Materials, ONDRAF/NIRAS, started out with the complete decommissioning of two small storage buildings up to green field level, a pilot programme with the aim to develop techniques suitable to be used for dismantling of contaminated process equipment, and the decontamination of building structures. Later on, techniques for dismantling and decontamination were optimised with the objective to facilitate work for the operators working in protective clothing under severe conditions in  $\alpha$ -contaminated cells, as well as to improve performances under real industrial conditions. To do so, an industrial dry abrasive decontamination facility for thorough decontamination of dismantled metallic parts was developed and implemented on the BELGOPROCESS site. This facility is in operation since the middle of 1996. Furthermore, shaving technologies were developed for the semi-automatic decontamination of thin layers of concrete on building structures generating small quantities of radioactive waste. From a total of 106 hot cells of the EUROCHEMIC main reprocessing building, 43 cells were completely dismantled by the end of 2004, 20 cells were empty and the decontamination of the infrastructure was in progress, and 37 cells were under dismantling of the process and other equipment.

### **BR3**

The decommissioning programmes started in 1989 also on the BR3 site of the Nuclear Research Centre, SCK•CEN. The BR3 reactor was the first PWR installed in Western Europe. Put into operation in 1962, it was definitely shut down in 1987. It was a low rated plant with an electrical net power output of 10.5 MWe. In 1989, BR3 was selected by the European Commission as a dismantling pilot project, in the framework of the third European Union five-year research programme on decommissioning of nuclear installations. This project involved three main operations up to the year 2000: the chemical decontamination of the plant primary loop, the selection and testing of techniques and tools for the remote dismantling of the highly activated reactor internals and finally the dismantling of all the internal structures. The dismantling of the reactor pressure vessel has been completed in 2000. Moreover, since 1995, dismantling of contaminated loops and concrete was started, and the dismantling of the plant primary loop and most parts of the secondary/tertiary loops are currently completed. The necessary decontamination systems have been developed and put in place as well as a complete material management system. In 2002, the spent fuel was transported to BELGOPROCESS for dry interim storage in Castor BR3 dual-purpose casks. In 2003

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<sup>15</sup> This section is essentially drawn from [NEA 2005] with some updates from [Belgoprocess 2006]



and 2004, a High Pressure Water Jet Cutting (HPWJC) device has been used successfully to cut pressure vessel parts into smaller pieces, as well as the primary pumps. The pressurizer, the steam generator and the neutron shield tank are going to be cut using this same HPWJC technique.

### **SCK-CEN (BP2)**

Furthermore, several buildings where physical, chemical and biological nuclear R&D was performed at the SCK•CEN site in Mol in the past, were decontaminated and released from radiological control in 1995-96. They are now used for conventional technological research by a Flemish research institute. Finally, in 1991, the remediation and decommissioning of the former waste management site of the SCK•CEN, which became the property of ONDRAF/NIRAS, that subcontracted the execution of the work to its subsidiary BELGOPROCESS, started with the cleanup of the historical waste. The decommissioning of redundant process and storage facilities began in 1998 on an industrial scale, and some facilities have now reached a green field status. (See Annex on Case Study Belgoproprocess for details).

Between 2001 and 2006 a part of the Pamela high-level waste vitrification facility was dismantled and adapted for reuse as an infrastructure for the treatment and conditioning of alpha contaminated solid waste. The parts of the installation that are obsolete are placed in a condition of non-operational stand-by and kept in safe conditions at minimum cost.

## **2.4 The status of waste management and disposal**

Currently there is no final disposal site operating in Belgium for any category of nuclear waste. Radioactive wastes arising from operation and decommissioning of nuclear facilities are transmitted to ONDRAF/NIRAS, and are processed and conditioned by incineration, super-compaction and cementation, etc., and stored by its subsidiary BELGOPROCESS at the Dessel site, e.g. while awaiting solutions for final disposal.

It is expected that a disposal facility for low-level waste (thus for a large share of the decommissioning waste) will be operational as of 2015/2016.

The majority of decommissioning waste is to be conditioned in large concrete monoblocks, which will require the construction of new conditioning facilities because the ones available are not designed for this type of work. Those new facilities will probably be built at the nuclear power plants sites. From there the conditioned waste shall be transported directly to the disposal site, which are assumed to be available in time. It is considered not appropriate to transport unconditioned waste to a central facility for conditioning from where it should be transported a second time to the final disposal site. For the operational and decommissioning waste from the EUROCHEMIC plant and the MOX plant of Belgonucleaire and alpha waste of other origin, a specific alpha waste facility is under construction at the Belgoproprocess site at Dessel. [MINECO 2005]

There is no legal definition of the starting point of decommissioning. Decommissioning is defined as the complete set of administrative and technical operations enabling a nuclear facility to be withdrawn from the list of classified installations as defined in terms of the dispositions of the Royal Decree of 20 July 2001.

As a result, the removal of the facility from the list of classified installations in terms of the dispositions of the Royal Decree of 20 July 2001 is considered to be the end point of decommissioning.

## 2.5 Responsibilities for decommissioning operations and costs

In the case of nuclear power plants, the ELECTRABEL subsidiary SYNATOM is responsible for managing nuclear provisions on behalf of ELECTRABEL and SPE (Public Electricity Society)<sup>16</sup>. ELECTRABEL and SPE remain liable for all costs regarding the future dismantling of the nuclear power plants, including cost overruns. Decommissioning activities will be carried out by nuclear operators on behalf of SYNATOM and spent fuel management will be carried out by the nuclear funding company.<sup>17</sup>

The national nuclear waste management agency ONDRAF/NIRAS plays a key role concerning decommissioning of nuclear facilities.

The Royal Decree of 30 March 1981, modified by the Royal Decree of 16 October 1991, determines its missions and conditions of operation. Regarding decommissioning, any person operating or applying for an authorization to operate a nuclear installation, must provide ONDRAF/NIRAS with all information relating to the planned decommissioning of their installation; the nature and quantities of resulting waste and the date of the waste's transfer to ONDRAF/NIRAS. This information must be provided within a reasonable timeframe and in any case no later than three years before the installation's final shut down. ONDRAF/NIRAS will also define, in consultation with the involved operators, the financing conditions for decommissioning shut down nuclear installations and for the management of their waste. (Operators of nuclear power plants are exempted from this provision, but must provide ONDRAF/NIRAS with the information necessary to carry out its responsibilities in that respect).

ONDRAF/NIRAS can also carry out decommissioning activities on behalf of the operator, on request, and negotiate an agreement specifying the technical and financial terms.

At present, ONDRAF/NIRAS is commissioned by the Belgian State with the dismantling of some significant installations, such as

- **Eurochemic** the former reprocessing plant (known as "BP1 liability")
- the former **waste treatment installations of SCK•CEN** ("BP2 liability")

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<sup>16</sup> SPE holds a 4% share in the nuclear units Doel -3 et -4 and Tihange-2 and -3

<sup>17</sup> Law of 11 April 2003, articles 12.3 & 12.4

- **BR3** research reactor and some decommissioned installations of **SCK•CEN**, (“technical SCK-CEN liability”)
- and some of the **IRE** (Institut des radioéléments, Fleurus) buildings (“IRE liability”).

The dismantling operations on the BP1 and BP2 sites have been entrusted by ONDRAF/NIRAS to its industrial subsidiary Belgoprocess. The financing of these activities is guaranteed until the end of the year 2008 by the Belgian State and the electricity sector via annual payments to a dedicated fund. Costs that will be arising from further decommissioning work by Belgoprocess after 2008 are not covered by any financing scheme yet.

With the law of 12 December 1997, ONDRAF/NIRAS also was given the mission to establish an inventory of all nuclear facilities and all sites containing radioactive substances. The purpose of this so called “liability inventory” is to draw-up a register specifying the location and condition of all nuclear facilities and all sites containing radioactive substances on Belgian territory, to estimate the cost of decommissioning and cleaning up these facilities and sites and to evaluate the availability of sufficient funds to carry out these ongoing or future operations. The inventory has to be sent to the competent minister, who can oblige the operator or owner to take corrective measures if considered necessary.

The first inventory report covering the year 1998 – 2002 was issued in January 2003, but it has not been made public.

From the regulatory point of view, FANC requires early guarantees that appropriate measures are taken for waste management. Indeed, the operational licence application must include an estimate of the waste quantities that will be produced during the dismantling of the installations. It also requests information on the management of that waste before being transferred to ONDRAF/NIRAS. At the time the installation is to cease its activities and is to be dismantled, the full procedure to obtain the required licences is applicable. [Belgium 2006b]

## 2.6 Cost estimates for decommissioning activities

According to the law of 11 April 2003, SYNATOM and the NPP operator have to provide the Surveillance Committee with a proposal on the revision of the methodology used for the provision of decommissioning, including a scenario for the decommissioning of nuclear power plants and management of spent fissile materials, a detailed cost estimate and disbursement planning (article 12.2).

Concerning the EUROCHEMIC and SCK-CEN facilities (BP1 and BP2) Belgoprocess has indicated the following principles are applicable for financing the decommissioning of nuclear installations making part of the nuclear liabilities of Belgoprocess [Belgoprocess 2006]:

1. The total decommissioning costs for dismantling installations are estimated based on the total material inventory of the installation. This necessary budget

for decommissioning, consisting of the total cost for dismantling, decontamination, demolition, site restoration, waste treatment, intermediate and final storage of the conditioned waste, stand-by cost and investments is described within the different initial decommissioning plans (continuously adapted during the total lifetime of the installation) and the final decommissioning plan (after shut down).

2. With programmes and budgets described in the different decommissioning plans, a long term program (for five years) was stipulated and was used as a bases for a Royal Decree that determines the different funds for the decommissioning and the management of the decommissioning programme for the period from 2004 to 2008.
3. Within this Royal Decree a fixed yearly payment was established. Yearly deposits will be done into a fund managed by NIRAS/ONDRAF, who is responsible to finance the executed decommissioning work by Belgoprocess.
4. For financing all decommissioning work in the period after 2008, new arrangements with the Belgian government have to be made.

Belgoprocess indicates in table 2b total decommissioning costs up to level 3 “green field” for the EUROCHEMIC reprocessing plant (BP1) of about € 200 million. This seems extraordinarily low, in particular for a plutonium bulk-handling facility. However, it should be noted that this figure does not include any costs for eventual reconditioning or management and disposal of any reprocessing wastes as in the case of the cost estimates for the French facilities at Marcoule and La Hague. But there are no external assessments of costing figures available.

In January 2003, ONDRAF/NIRAS issued the first “Inventory of Nuclear Liabilities” covering the period 1998-2002. The report itself is not public. The main conclusions, surprisingly critical of the overall situation, as published by ONDRAF/NIRAS are<sup>18</sup>:

In addition to the costs presently not covered, the exercise has revealed certain weak points that could put into jeopardy the availability and the sufficiency of the financial provisions accumulated. These weak points need corrective measures that are within the competence of the Minister in charge:

*Identification of the financial responsibilities for certain sites.* In most of the cases the legal situation is simple, the operator being identical with the owner of the facilities. However, certain sites have a complex legal situation. Who is financially responsible for the site, the operator, the owner of the facilities, the owner of the site hosting the facilities, the tenant of the facilities or someone defined as responsible within a contract that links the parties? The distribution of obligations between owners and operators should be determined in accessible conventions.

*Determination of existence or lack of provisions of organisations that are not submitted to accountancy obligations (the Belgian state, universities...) and the evaluation of provisions that have been eventually collected.* The analysis of the financial reports submitted to the National Bank by companies that have to fulfil that obligation can turn out difficult.

*Availability of financial means collected.* The financial means underlying the accounting provisions introduced in the annual reports of companies are generally reinjected into the operation of the companies, which, considering the economic uncertainties can jeopardise their availability in the long term.

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<sup>18</sup> ONDRAF/NIRAS, Monitoring territoire belge 1998-2002 achevé, Dossier de Presse 28/3/2003, [http://www.nirond.be/francais/PDF/Dosinfo\\_inventaire\\_280103\\_FR\\_Print.pdf](http://www.nirond.be/francais/PDF/Dosinfo_inventaire_280103_FR_Print.pdf)

*Sufficiency of the financial means.* The coverage of the nuclear costs by a financial mechanism suggests the upholding of this mechanism for the entire operating period of the corresponding facilities as initially planned. The risk of premature closure of the facilities or insufficiency of the planned mechanisms raise the question of the solidarity between the actors of the nuclear sector and with the Belgian state.

*Uncertainty about the real costs.* The calculation of the real costs is surrounded by uncertainties that result at the same time from the working hypotheses applied, in particular concerning the management scenarios envisaged, and the evolution with time of legislation, standards and techniques. These uncertainties are partially covered by a margin that is included in the calculation of the provisions. Once this reserve is exhausted, the state will be the only financial guarantor of the long term financing of the safe disposal of radioactive substances”.

*The fiscal deductibility of the provisions.* The lack of fiscal deductibility of nuclear provisions, with the exception of those set up by the nuclear power plants, constitutes a restraint for their constitution in the opinion of numerous financial officials.

Regarding the annual report the Surveillance Committee has to produce, the minister in charge of energy stated in October 2005 that he has asked for the first report, covering the year 2004, to be transmitted “as soon as possible”.<sup>19</sup> *However, nothing has been published since. Administrations that are represented on the Surveillance Committee have not published any information neither. For example, the director general of the safety authority FANC is a member of the Committee. But no information is provided by FANC on the issue.*

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<sup>19</sup> Chambre des représentants de Belgique, Commission de l'Economie, de la Politique scientifique, de l'Education, des Institutions scientifiques et culturelles nationales, des Classes moyennes et de l'Agriculture, Compte rendu intégral, 20.09.2005; <http://www.dekamer.be/doc/CCRI/pdf%5C51%5Cic691.pdf>

Table 2a Overview on decommissioning costs for one specific NPP in Belgium (in prices of 2004 [data not made available<sup>20</sup>])

Decommissioning activity	Years the activity took place / is expected to take place	Total decommissioning costs [Mio. Euro]	Annuity of decommissioning costs in relation to output over lifetime [ct/kWh; 4%]	Remarks #e.g. with regard to time horizons and interest rates used for calculation, or with regard to the question in how far any transport between processing facilities is taken into account#
Facility shutdown and pre-decommissioning activities				
Spent fuel management (interim storage, reprocessing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)				
Management of other (low and intermediate) radioactive wastes arising from reprocessing, and storage and disposal of these wastes covering the whole lifetime of the NPP				
Management of other radioactive waste from operation of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP				
Safe enclosure				
Dismantling (nuclear) and decontamination activities				
Decommissioning waste management (processing, storage and disposal of radioactive waste from decommissioning)				
Decommissioning of non-radioactive parts (conventional dismantling)				
Site restoration, cleanup and landscape				
Supporting programmes for employees				
Supporting programmes for regional development				
<b>TOTAL</b>				

<sup>20</sup> Unfortunately Electrabel, SCK/CEN, FBFCI and BELGONUCLÉAIRE never responded to the questionnaire that was sent out by the author in May 2006.

Table 2b: Overview on decommissioning costs for the **EUROCHEMIC reprocessing plant (BP1, Mol)** (in prices of 2004)

Decommissioning activity	Years the activity took place / is expected to take place	Total decommissioning costs [Mio. Euro]	Annuity of decommissioning costs in relation to output over lifetime (Mio.Euro/Mg)	Remarks e.g. with regard to time horizons and interest rates used for calculation, or with regard to the question in how far any transport between processing facilities is taken into account
Facility shutdown and pre-decommissioning activities	1975-1985	n.a.		
Spent fuel management (interim storage, reprocessing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)	-			
Management of other (low and intermediate) radioactive wastes arising from reprocessing, and storage and disposal of these wastes covering the whole lifetime of the NPP	-			
Management of other radioactive waste from operation of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP	-			
Safe enclosure	-			
Dismantling (nuclear) and decontamination activities	1989-2009	151.7	0.715	104.7 Mio.Euro decommissioning costs 47.0 Mio.Euro stand-by and operational costs
Decommissioning waste management (processing, storage and disposal of radioactive waste from decommissioning)		44.4	0.209	
Decommissioning of non-radioactive parts (conventional dismantling)				
Site restoration, cleanup and landscape	2008-2011	7.2	0.034	demolition of the building and free release of the produced concrete
Supporting programmes for employees				
Supporting programmes for regional development	-			
<b>TOTAL</b>		<b>203.3</b>	<b>0.958</b>	

Source: Belgoprocess Decommissioning - [Belgoprocess 2006]

Table 3 Expected total costs of future decommissioning of nuclear installations in Belgium (in prices of 2004)

Short name of nuclear facility	Kind of facility:	Years decommissioning activities are expected to take place	Total decommissioning costs estimated [Mio. Euro]	Annuity of estimated decommissioning costs in relation to output over lifetime	Remarks
Tihange and Doel	NPP	After 2015 <sup>21</sup>	1,376.4		3% per year (5% discount rate and 2% inflation); asset is depreciated over 40 years
EUROCHEMIC	Reprocessing	1989-2011	203.3	0.958 MEUR/Mg	
SCK/CEN	R&D + Waste	After 2015	46.9		
Belgonucléaire	MOX Fabrication	n.a.	90.0		
FBFCI	Fuel Fabrication	n.a.	16.4		
<b>Total</b>			<b>1,733.0</b>		

Sources: [Belgoprocess 2006] for EUROCHEMIC, [ELECTRABEL 2006] for Tihange and Doel, others from [MINECO 2005]

ELECTRABEL has provided the following figures in its Annual Report 2005 (see [ELECTRABEL 2006])

	as of 31 Dec 2004	as of 31 Dec 2005	
Dismantling of			
Tihange and Doel	1,495	1,569	
Spent Fuel and Waste			
Processing and Storage	2,676	2,875	
<b>Total NPPs</b>	<b>4,171</b>	<b>4,444</b>	

While it seems obvious that table 3 does not include spent fuel and waste management costs, it is unclear why the figures for decommissioning of the seven ELECTRABEL reactors vary by more than € 100 million.

<sup>21</sup> start of decommissioning operations within 5 to 8 years after shut down, cash outflow planned to occur for about 7 years after the start of dismantling until 2044; all waste to be buried by 2080, according to [Electrabel 2006]



### 3 Funds and fund management

Article 16 of the 1981 Royal Decree stipulates that ONDRAF/NIRAS, with the agreement of the Minister of Economic Affairs, “can constitute a Fund for the financing of its long-term missions”. Thus the establishment of the Fund is not an obligation for ONDRAF/NIRAS but an option.

The Fund shall cover the costs of the final disposal of radioactive wastes, in particular their eventual geological disposal. It shall also cover costs that might come up after the period of 50 years as a result of potentially defective waste conditioning that was impossible to detect when the waste was transferred to ONDRAF/NIRAS.

The Fund shall be fed by contributions from the waste producers as a pro rata function of their waste generation. The ONDRAF/NIRAS board submits for approval to the Minister of Economic Affairs the rules that fix the respective levels of the contributions and the conditions of the use of the funds. The conventions signed between ONDRAF/NIRAS and the waste producers fix the details. ONDRAF/NIRAS has to provide an annual report about the technical and financial status of the conditioned waste management.

ONDRAF/NIRAS agrees with the operators the financing conditions for the decommissioning of their facilities and the management of resulting wastes. Producers that have signed a convention with ONDRAF/NIRAS prior to 9 October 1985, date of the signature of the convention between ONDRAF/NIRAS and ELECTRABEL, are exempt from the application of this article.

The nuclear phase-out law of 31 January 2003 stipulates that the provisions for the management of spent fuel and wastes from the operation and decommissioning of nuclear power plants must be accrued over the expected lifetime of the facility, that is 40 calendar years from start-up at the most. The current scenario is a dismantling approach based on the separate dismantling of each unit and the decommissioning of the common facilities well after the decommissioning of the last unit on each site. The initial provision corresponds to the discounted value of all calculated future decommissioning expenses. The cost evaluation is based on studies by the Belgian engineering company Tractebel and the German engineering company NIS. These studies are not publicly available.

The law requires a review every three years and a formal approval by the Surveillance Committee of any changes in methodology, funding or investment policy. For the conclusions of the Surveillance Committee with respect to the sufficiency of financial provisions the unanimous opinion of ONDRAF/NIRAS is needed.

The Royal decree of 24 March 2003 creates the legal framework for a structural financing mechanism of these dismantling activities on the BP1 and BP2 sites until their completion by a levy on the delivered kWh. The BP1 & BP2 liability funds were set up in 1989 to finance respectively the former EUROCHEMIC reprocessing facilities in Dessel (BP1) and the former waste processing activities of the Nuclear Research

Centre SCK•CEN in Mol (BP2). Financing of these activities are guaranteed by a Royal Decree via an annual federal contribution fixed until the year 2008. BP1 is planned to be dismantled by 2008, the demolition of the structure to green field is to be carried out between 2008 and 2011. Availability of funding beyond 2008 is unspecified and therefore uncertain.

In the law of 11 April 2003 on decommissioning funds for nuclear power plants and spent fissile materials management, provisions for decommissioning are defined as: provision for costs for shut-down of the power plant's reactor and nuclear fuel unloading, decommissioning of the facility, site clean-up and management of nuclear waste arising from it (article 2.2), and provision for spent fissile material management as provision for costs linked to management of fissile material irradiated in power plants (article 2.3). In other words, provisions for decommissioning and for spent fuel management are set up separately with the exception of the case of the BR3 reactor.

However, the decommissioning fund covers only the activities necessary to withdraw the nuclear facility from the list of classified nuclear installations as defined in terms of the dispositions of the Royal Decree of 20 July 2001. This means that the implementation of further activities, at least for some facilities, in order to achieve "green field" conditions is not covered. In the case of the so-called "nuclear liability programmes", and for the nuclear power plants financial means are theoretically provided up to "green field" conditions.

No information is available about social measures (redeployment, local and regional development measures) by most of the operators. The operator of the Belgonucléaire plutonium fuel plant has declared that social measures are not covered by its decommissioning provisions.

According to the law of 11 April 2003, the operator had to transfer to the provision company, by 31 December 2003 at the latest an amount equal to the value of the provisions already constituted. Beginning with fiscal year 2003 provisions are transferred on a quarterly basis (article 11.2).

On 19 December 1990, the Belgian state, ONDRAF/NIRAS, SYNATOM and the power producers ELECTRABEL and SPE signed a "Convention relative to the establishment and the management of a fund for the clean-up of nuclear installations of the Mol-Dessel site"<sup>22</sup>. The fund has received annual payments by the state. The complete series of annual payments is not available, but in 2003 the state has transferred € 38 million to the fund<sup>23</sup> and for the period 2004-2008, the annual amount is

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<sup>22</sup> Convention relative à la création et à la gestion d'un fonds d'assainissement d'installations nucléaires du site de Mol-Dessel, 19 December 1990 and subsequent amendments, signed by the Belgian state, ONDRAF/NIRAS, SYNATOM and the power producers ELECTRABEL and SPE

<sup>23</sup> Arrêté royal fixant les montants destinés au financement des passifs nucléaires BP1 et BP2 pour la période 2004-2008, en exécution de l'article 4, § 2, de l'arrêté royal du 24 mars 2003 fixant les modalités de la cotisation fédérale destinée au financement de certaines obligations de service public et des coûts liés à la régulation et au contrôle du marché de l'électricité [http://www.juridat.be/cgi\\_loi/loi\\_F.pl?cn=2003121937](http://www.juridat.be/cgi_loi/loi_F.pl?cn=2003121937)

€ 55 Million Euro.<sup>24</sup> The fund is fed by a levy on the distributed kWh. The grid operator must transfer towards a separate ONDRAF/NIRAS account one forth of the amount on a quarterly basis.

The law of 24 December 2002<sup>25</sup> provides for the implementation of a federal levy on the distributed electricity in order to cover various specific programs including the BP1 and BP2 decommissioning, clean-up and decommissioning waste management.

### 3.1 Management of funds

In the case of the **nuclear power plants**, SYNATOM is responsible for establishing nuclear provisions on behalf of ELECTRABEL and SPE (Public Electricity Society).

In the case of the "**nuclear liability programmes**", the Belgian State is responsible to collect the necessary funds, but it is ONDRAF/NIRAS who holds them. In October 2005 the Gas and Electricity Regulatory Commission (CREG) took over € 13.75 billion in provisions only to refund them to ONDRAF/NIRAS in the beginning of 2006. The reason for the manoeuvre is unclear. [CREG 2006]

In the case of all **other facilities**, it is the owner who holds the funds.

SYNATOM can lend, at the usual rate for industrial credits, up to a maximum of 75 % (percentage to be revised in function of the solvency of the nuclear operators) of the provisions to the nuclear power plant operators, who have to be considered as debtors of good quality. This quality has to be evaluated periodically by means of a debt rating with regard to the own assets and of a credit rating fixed by an internationally recognized quotation agency. During the first two years after the publication of the law in the Official Collection of Laws, the loan percentage was allowed to be 100 %.

The loan conditions have to be fixed in one or more agreements concluded between the nuclear provision company and the nuclear operators. The Surveillance Committee has to check the compliance of these conditions with the law and can require changing these conditions if they are contrary to the law.

In the case of SYNATOM, 25 % of the provisions (or more if the loan percentage has been revised downwards from 75%) has to be invested in assets outside the nuclear operators, with attention to a sufficient diversification and spread of investments in order to minimise the risk. The Surveillance Committee has to approve the categories of assets in which SYNATOM is allowed to invest the 25 % (or more) of the provisions.

According to ELECTRABEL, in 2005 the Surveillance Committee "has ruled out the investments made by Synatom. The committee has challenged Synatom's interpretation of the legal criteria for the types of assets on which it can invest. As permitted by the legislation, Synatom has appealed against this ruling to the Minister of Energy" [ELECTRABEL 2006]. No information is available as to the current status of the dispute.

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<sup>24</sup> Royal Decree, 19 December 2003

<sup>25</sup> Moniteur Belge, 31.12.02

Concerning liquidity requirements, the provision company must retain at all times sufficient liquid assets, in the form of shares or available stock, in order to finance all expenses linked to decommissioning and management of spent nuclear material for the following three years of operation.

The Belgian state holds a “golden share” in SYNATOM, which gives it the power to veto decisions of the major shareholders.

The Surveillance Committee shall report on the yearly basis to the minister in charge of energy. It also produces an audit, every three years, on the basis of the documents provided by ELECTRABEL and SYNATOM. The advice formulated by the Surveillance Committee is binding for SYNATOM, but the latter can appeal to the minister of energy. The principle is somewhat confusing since the Government can already veto the decision making within SYNATOM.

The Belgian Electricity and Gas Regulation Commission (CREG) has issued an important report in 2001 on the issue of backend funds and their management [CREG 2001]. Unfortunately, the report is largely outdated with the more recent changes in the legal and regulatory framework. However, an update of the analysis would be extremely useful.

### **3.2 Special cases: Fall-back option and transfer of ownership**

The Royal Decree of 31 March 1981 stipulates that ONDRAF/NIRAS shall establish a 5% reserve included in the fees that it charges in order to be able “to face bankruptcy or eventual insolvability of certain producers”. The financial resources collected are fed into a separate fund that was set up only in 1992. The disbursements from this fund shall serve exclusively the financing of uncovered costs following bankruptcy and insolvability of producers.

Table 4 Base for decommissioning funds required

Short name of nuclear facility	Kind of facility:	Decommissioning funds are based on discounted decommissioning costs (MEUR)	Discount rate used for discounting	Reference date used for discounting	Remarks
Tihange, Doel	NPPs (2) + spent fuel management	1,376 2,540	3% per year (5% discount rate and 2% inflation)		
EUROCHEMIC	Reprocessing	203.3			
SCK/CEN	R&D + Waste	46.9			
Belgonucléaire	MOX Fabrication	90.0			
FBFCI	Fuel Fabrication	16.4			
<i>Total</i>		<i>4,273.0</i>			

Sources: [Belgoprocess 2006] for EUROCHEMIC, [ELECTRABEL 2006] for Tihange and Doel, others from [MINECO 2005]

Table 5: Decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in Belgium (in prices of 2004)

Short name of nuclear facility	Kind of facility:	Total decommissioning costs estimated [Mio. Euro]	Provisions accumulated by 31-12-2004 [Mio. Euro]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]	Remarks
Belgoprocess	not applicable to the financing of the decommissioning of the nuclear passive of Belgoprocess (1)					
Doel, Tihange	NPPs (2) + spent fuel management	2,300 7,450	1,376 2,540	60% 34%	various	

Sources: (1) [Belgoprocess 2006] ; (2) [ELECTRABEL 2006] and [Verwilghen 2005]

(2) Marc Verwilghen, Minister of Economy, Energy, External trade, and scientific policy, Answer to a parliamentary question, Chambre des représentants de Belgique, Commission de l'Economie, de la Politique scientifique, de l'Education, des Institutions scientifiques et culturelles nationales, des Classes moyennes et de l'Agriculture, Compte rendu intégral, 27.04.2005

Table 6 Management of decommissioning funds in Belgium

Short name of nuclear facility	Kind of facility	Provisions accumulated by 31-12-2004 [Mio. Euro]	... of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. Euro]	... of which has been accumulated by the operator of the facility or its mother company within a separated account / segregated fund [Mio. Euro]	... of which has been accumulated in an external fund under public control [Mio. Euro]	... of which has been accumulated in an external fund under mixed private-public control [%]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]	Remarks
Doel, Tihange	NPPs (2) + spent fuel management	1,376 2,540				25	75	It is not a clear-cut scheme: SYNATOM is a 100% daughter company of the operator, but government holds golden share

## 4 Transparency of the funding schemes to the public

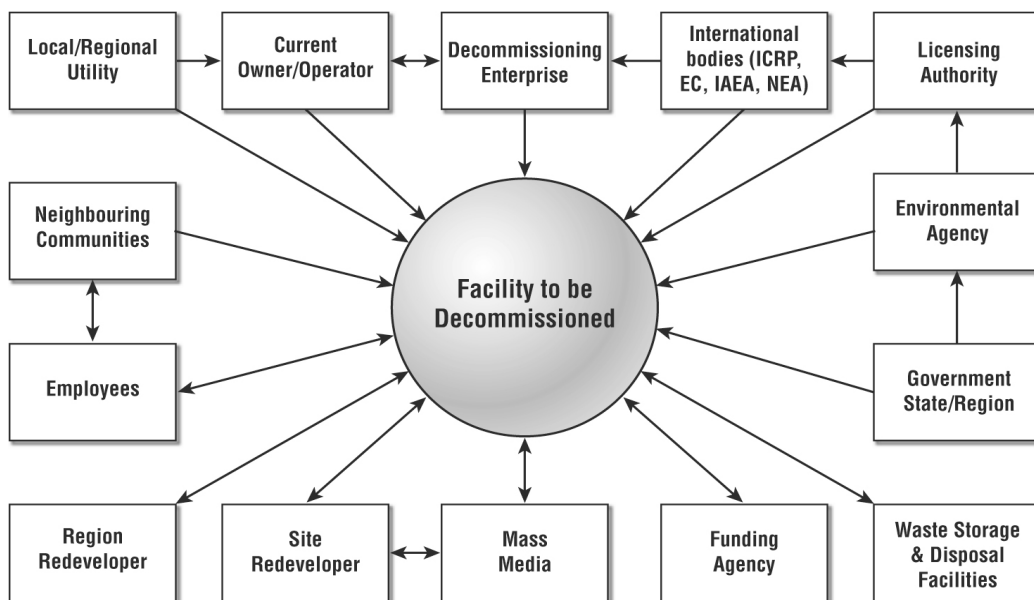
Very little information is publicly available on details of the funding scheme. Key missing data include :

- information on decommissioning and waste management costs; evaluation carried out by external experts;
- company and facility specific details on decommissioning costs;
- company specific financial risk analysis;
- the report by the Surveillance Committee to the Government ;
- information on the investment of funds built up by backend provisions;
- information on the specific issue of cross-border ownership and control over funds (in particular recent agreements between ELECTRABEL, SUEZ and the Belgian government).

## 5 Stakeholder analysis

The Ministry of Economy has provided a useful diagram on the stakeholders involved in the issue of decommissioning.

Figure 1: Public stakeholders



3571/abbs/fig\_1\_Stakeholders\_2.eps/jpg/shu/24.02.05

Source: MINECO 2005

The following notes provide only a partial overview of some stakeholder positions. However, when it comes to positions and influence of the various stakeholders in the decision making process available information is rather scarce. It is difficult to judge



whether this is linked to a low level of involvement or a lack of available primary information on the issue.

### **Politicians and Government**

The current Belgian system has recently been put into question by a number of politicians that have suggested to use some of the provisions for other than earmarked purposes. The Socialist Party, for example, has suggested to use € 1 billion from the decommissioning funds held by SYNATOM in order to finance a national energy conservation fund.<sup>26</sup>

On the other hand, the government of Guy Verhofstadt is reported to have negotiated with ELECTRABEL and SUEZ that the provisions, while invested primarily in Belgium, essentially remain in the balance sheets of the operators. The composition of the Surveillance Committee is also up for negotiation. The operator wishes to enter a replacement structure that takes up the Committee's role.<sup>27</sup> At the same time it has been stated that the "The agreement with the government of Guy Verhofstadt « also foresees closer state oversight over the use of financial provisions for decommissioning of Belgium's seven PWR units" At this point, it is unclear what the outcome of the negotiations has been or will be.

### **State Administration**

MINECO representatives have requested a "clear description of what is understood by decommissioning". They also have stated: "There may be some needs for harmonisation at the European level, especially in the way the necessary provisions are constituted. In a liberalised market, however, the management of the funds should be left more free. It is an element of competition that one company tries to do better than another one in this respect." [MINECO 2005] The apparent contradiction between the call to harmonise fund regulation and to liberalise it at the same time could not be elucidated.

### **NIRAS/ONDRAF**

NIRAS/ONDRAF finds it important to fix a clear starting point for decommissioning in order to be able to determine the decommissioning costs in the context of the inventory of nuclear facilities and sites and of the requirements to constitute the necessary funds. The termination of the operational activities is proposed as starting point. This is however not considered appropriate by the government, since some decommissioning activities take already place before this date. [MINECO 2005]

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<sup>26</sup> Elio Di Rupo, Discours au Congrès de rentrée, 3 September 2006

<sup>27</sup> [http://www.lesoir.be/actualite/economie/2006/10/05/article\\_energie\\_le\\_gouvernement\\_et.shtml](http://www.lesoir.be/actualite/economie/2006/10/05/article_energie_le_gouvernement_et.shtml)

## 6 Conclusions

Belgium has set up a heterogeneous system for cost assessment and financing of nuclear decommissioning and waste management. The cost assessment for decommissioning is partly done by external engineering companies whose reports are not publicly available. The cost evaluation for spent fuel and radioactive waste management, remain highly speculative in the absence of any final disposal site.

There are several funding schemes:

In the case of the seven **nuclear power plants**, the nuclear fuel company SYNATOM, a subsidiary of ELECTRABEL, is responsible for establishing and managing nuclear provisions on behalf of ELECTRABEL and SPE (Public Electricity Society). The provisions are subject to discounting calculated on a maximum commercial operating lifetime of 40 years. The discount level applied is 3% per year (5% discount rate and 2% inflation).

In the case of the so-called **nuclear liability programmes**, which include the shut-down reprocessing plant EUROCHEMIC and waste conditioning facilities in Mol, the Belgian State is responsible to collect the necessary funds via a levy on the distributed kWh that the distributor has the right to pass on to the final electricity customer. But it is the national waste management company ONDRAF/NIRAS that holds and manages the fund.

In the case of all **other facilities**, it is the owner or operator who holds the funds.

ONDRAF/NIRAS has identified a number of weaknesses in the system “that could put into jeopardy the availability and the sufficiency of the financial provisions accumulated”, which need corrective measures”. These include:

- The Identification of the financial responsibilities for certain sites is difficult. Who is financially responsible for the site, the operator, the owner of the facilities, the owner of the site hosting the facilities, the tenant of the facilities or someone defined as responsible within a contract that links the parties?
- The determination of the existence or the lack of provisions of organisations that are not submitted to accountancy obligations (the Belgian state, universities...) can turn out difficult.
- The financial means underlying the accounting provisions are generally reinjected into the operation of the companies, which, considering the economic uncertainties, can jeopardise their availability in the long term.
- The coverage of the nuclear costs by a financial mechanism suggests the upholding of this mechanism for the entire operating period of the corresponding facilities as initially planned. The risk of premature closure of the facilities or other disruptions raise the question of the backup financial mechanisms.

- The cost calculations are surrounded by uncertainties that are only partially covered by a margin that is included in the calculation of the provisions. Once this reserve is exhausted, the state will be the only financial guarantor of the long term financing of the safe disposal of radioactive substances.
- According to a number of financial officials the lack of fiscal deductibility of nuclear provisions, with the exception of those set up for the nuclear power plants, constitutes a restraint for their constitution.

In fact, even in the short term the financial mechanisms remain unclear. The current agreement between the government and nuclear operators only runs until 2008. In addition, there seem to be political initiatives to make at least a part of the provisions available for other government programs. Such practice would likely jeopardise the entire mechanism.

From the available information one concludes, that the successful application of the polluter-pays principle on the nuclear backend costs does not seem to be guaranteed yet in Belgium. Large uncertainties remain, in particular on the cost assessment for final disposal of radioactive wastes. A significant problem is the lack of access to information. All underlying reports on facility specific cost calculation remain confidential and even the reports of the governmental Surveillance Committee that monitors organisation and management of backend provisions are not publicly accessible.

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## **8 Annexes**

Annex 1 : Questionnaire Belgoprocess

**Annex 1**

# **MYCLE SCHNEIDER CONSULTING**

## ***Independent Analysis on Energy and Nuclear Policy***

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## **Comparison among different decommissioning funds methodologies for nuclear installations**

**Commissioned by the European Commission**

**Project n°TREN/05/NUCL/S07.55436**

## **Case Study : Nuclear facilities operated by Belgoprocess**

**Paris, May 2006**

Table 7 Selection of nuclear installations operated by BELGOPROCESS in Belgium

Nuclear facility	Short name	Country	Kind of facility	Output /Nominal capacity	Operational period	Operating company	Name of quoted companies holding shares in the nuclear facility, if any	Percentage of shares held [%]	Decom started/will start in year	Decom stage	Analysed in this report
<i>Belgoprocess Dessel</i>	Pamela	BE	Conditioning of liquid waste (LEWC and HEWC)	62,5 m <sup>3</sup> LEWC 894,6 m <sup>3</sup> HEWC	1985 - 1991	Belgoprocess			(1)	Partially dismantled for reuse, partially in non-operational stand-by	x
<i>Belgoprocess Dessel</i>	Eurochemic reprocessing plant	BE	Reprocessing	181,5 Mg natural and slightly enriched uranium fuels  30,6 Mg high enriched uranium fuels	1966 - 1974	Belgoprocess			1989	Dismantled by 2011, including the demolition of the structure to green field	x

(1) 2001 - 2006, dismantling of a part of the installation for reuse as an infrastructure for the treatment and conditioning of alpha contaminated solid waste. The not reused part of the installation is placed in a condition of non-operational Stand-by, kept in safe conditions at a minimum cost.



Table 8 Overview on decommissioning costs for BELGOPROCESS PAMELA-plant (Mol) (in prices of 2004)

Decommissioning activity	Years the activity took place / is expected to take place	Total decommissioning costs [Mio. Euro]	Annuity of decommissioning costs in relation to output over lifetime	Remarks e.g. with regard to time horizons and interest rates used for calculation, or with regard to the question in how far any transport between processing facilities is taken into account
Facility shutdown and pre-decommissioning activities	Due to the fact that this installation is in reuse, all requested data are not available at this moment.			
Spent fuel management (interim storage, reprocessing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)				
Management of other (low and intermediate) radioactive wastes arising from reprocessing, and storage and disposal of these wastes covering the whole lifetime of the NPP				
Management of other radioactive waste from operation of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP				
Safe enclosure				
Dismantling (nuclear) and decontamination activities				
Decommissioning waste management (processing, storage and disposal of radioactive waste from decommissioning)				
Decommissioning of non-radioactive parts (conventional dismantling)				
Site restoration, cleanup and landscape				
Supporting programmes for employees				
Supporting programmes for regional development				
<b>TOTAL</b>				

Source:

Table 9: Overview on decommissioning costs for EUROCHEMIC's reprocessing plant (Mol) (in prices of 2004)

Decommissioning activity	Years the activity took place / is expected to take place	Total decommissioning costs [Mio. Euro]	Annuity of decommissioning costs in relation to output over lifetime (Mio.Euro/Mg)	Remarks e.g. with regard to time horizons and interest rates used for calculation, or with regard to the question in how far any transport between processing facilities is taken into account
Facility shutdown and pre-decommissioning activities	1975-1985	n.a.		
Spent fuel management (interim storage, reprocessing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)	-			
Management of other (low and intermediate) radioactive wastes arising from reprocessing, and storage and disposal of these wastes covering the whole lifetime of the NPP	-			
Management of other radioactive waste from operation of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP	-			
Safe enclosure	-			
Dismantling (nuclear) and decontamination activities	1989-2009	151,7	0,715	104,7 Mio.Euro decommissioning costs 47,0 Mio.Euro stand-by and operational costs
Decommissioning waste management (processing, storage and disposal of radioactive waste from decommissioning)		44,4	0,209	
Decommissioning of non-radioactive parts (conventional dismantling)				
Site restoration, cleanup and landscape	2008-2011	7,2	0,034	demolition of the building and free release of the produced concrete
Supporting programmes for employees				
Supporting programmes for regional development	-			
<b>TOTAL</b>		<b>203,3</b>	<b>0,958</b>	

Source: Belgoprocess Decommissioning

Table 10 Expected total costs of future decommissioning of nuclear installations in Belgium operated or co-operated by BELGOPROCESS (in prices of 2004)

Short name of nuclear facility grouping for types of facilities possible	Kind of facility: NPP = nuclear power plant	Years decommissioning activities are expected to take place	Total decommissioning costs estimated [Mio. Euro]	Annuity of estimated decommissioning costs in relation to output over lifetime	Remarks e.g. with regard to time horizons and interest rates used for calculation
101B + 101C	warehouses for decommissioning equipment	2015	n.a.		All installations are making part of the nuclear passive of Belgoprocess.
102X	Reception Building, head-end cells of the reprocessing facility	starting in 2011	n.a.		
105X/122X/121X	Storage facilities for high active liquid waste	starting in 2010	n.a.		
102A	Storage facility for high active solid waste	starting in 2014	n.a.		
234G	Transfer station for medium act. sludge	2004 - 2006	n.a.		
270A	Storage facility for non conditioned R.A. waste	2009 - 2010	n.a.		
270B	Storage facility for non conditioned R.A. waste	2009 - 2010	n.a.		
236A	Incinerator for beta-gamma solid waste	2009 - 2014	n.a.		
235A	Water treatment, for high active liquid waste	2009 - 2015	n.a.		
250PRS/239X, 270K	Storage facilities for active liquid waste	starting in 2015	n.a.		
270M, 270L	Interim storage facility for conditioned and non conditioned R.A. waste	starting in 2015	n.a		
The decommissioning of different storage and waste treatment facilities making part of the nuclear passive is foreseen, but not planned in detail, after the year 2015. Those decommissioning activities will be financed on the same basis as the decommissioning of all installations making part of the above indicated list.					

n.a. : not available, Source : Belgoprocess Decommissioning

## **Funds and fund management**

### **Setting aside funds**

Please answer the following questions:

How are the estimated costs accounted for?

Who is responsible for setting up the provisions/accruals?

How are the accruals set up?

Is collection of all financial means for decommissioning defined at start-up of facility operation and ended before shut down?

When should the total funds be available?

Do the provisions cover all the cost items mentioned in Table 2?

How are the financial provisions transferred to the fund?

What are the sources of contribution to the fund? (public, private; fees, included in energy prices, etc.)

Legal requirement or (international) standards applied to (accounting) methodology of setting aside funds?

What is the base for setting up the accruals: overnight/undiscounted or discounted decommissioning costs? Discount rates and reference dates for discounting?

In how far is it secured that contributions will change in case of change of cost estimates or other important changes?

*The different principles described below are only applicable for financing the decommissioning of the installations making part of the nuclear passive of Belgoprocess. Where the Belgian Government or NIRAS-ONDRAF are the owners of all those installations, Belgoprocess is the responsible nuclear operator.*

*The nuclear passive of Belgoprocess are :*

- all installations that were part of the Eurochemic reprocessing facility, inclusive the auxiliary installations and those installations used for the further processing of secondary waste streams produced during reprocessing (e.g. the PAMELA installation for the vitrification of high active liquid waste)*
- and the installations of the former waste treatment plant coming from the SCK-CEN, inclusive the new necessary installations for the further treatment of existing waste on site, accepted before 1989.*

*As an answer on all questions, the following principles are applicable for financing the decommissioning of nuclear installations making part of the nuclear passive of Belgoprocess :*

- The total decommissioning costs for dismantling installations are estimated based on the total material inventory of the installation. This necessary budget for decommissioning, consisting out of the total cost for dismantling, decontamination, demolition, site restoration, waste treatment, intermediate and*

*final storage of the conditioned waste, stand-by cost and investments is described within the different initial decommissioning plans (continuously adapted during the total lifetime of the installation) and the final decommissioning plan (after shut down).*

- *With programmes and budgets described in the different decommissioning plans, a long term program (for five years) was stipulated and was used as a bases for a Royal decree that determines the different funds for the decommissioning and the management of the decommissioning programme for the period from 2004 to 2008.*
- *Within this Royal decree a fixed yearly payment was established. Yearly deposits will be done into a fund managed by NIRAS/ONDRAF, who is responsible to finance the executed decommissioning works by Belgoprocess.*
- *For financing all decommissioning works in the period after 2008, new arrangements with the Belgian government have to be made.*

*For new waste treatment and storage facilities constructed on site for and owned by NIRAS-ONDRAF, different principles are applicable.*

### **Management of funds for the decommissioning costs of the nuclear passive of Belgoprocess**

Please answer the following questions:

Who manages the funds?

*As described in the former paragraph, yearly payments by the Belgian Government into a fund on a bank or savings account are controlled and managed by NIRAS-ONDRAF.*

Is the fund internally/externally, segregated/non-segregated, public/private managed?

Who has access to the funds to what extent and according to which regulations?

*As stipulated in a commercial contract between Belgoprocess and NIRAS-ONDRAF, based on normal quotations and orders for ongoing decommissioning works, invoices in relation to the progress of the dismantling and decontamination works are submitted to NIRAS-ONDRAF on a three-monthly basis. Those invoices accompanied by the necessary technical reporting are paid by NIRAS-ONDRAF out of the fund for decommissioning.*

Who decides about the investment of the financial means /investment strategy of the funds?

*Firstly the decommissioning strategy, including the necessary research and development programmes, are described and accepted by NIRAS-ONDRAF in the different decommissioning plans. Furthermore are those programmes and the related investments integrated into the long term programmes approved by the Belgian Government. Based on yearly budgets and quotations decommissioning works, including the necessary investments are ordered by NIRAS-ONDRAF by Belgoprocess.*

Are there any liquidity requirements?

What are the internal control systems, audits, boards?

*All decommissioning works are ISO9001, ed. 2000 certified.*

*Between the responsible contract managers of NIRAS-ONDRAF and Belgoprocess the progress within the different decommissioning projects is discussed on a monthly basis. Three-monthly, progress, including all financial aspects, are discussed and a proposal for the related invoices is approved.*

What is the role of the state? Are there external control systems, systematic audits, reviews?

*In a Technical Comity NIRAS-ONDRAF has to report the progress and financial consequences of all decommissioning activities to representatives of the Belgian Government on a three-monthly basis. All expenses and investments are discussed and normally approved. During this periodic meeting new programs or changes in dismantling and decontamination or research and development programmes can be discussed and can be started after mutual agreement.*

How are the financial means used until they are needed for their original decommissioning purposes?

*All funds are managed on normal bank or savings accounts.*

Who benefits from the investment performance? Profitability of investment of financial means from decommissioning funds?

*All interests are capitalised on the same accounts.*

How are the security and/or uniqueness of the destination of the funds guaranteed?

*As the responsible owner, partially on the basis of a long lease contract with the Belgian Government for the former Eurochemic installations, NIRAS-ONDRAF, as a governmental institute, is responsible for the total decommissioning programme executed on both sites of Belgoprocess. In this matter they are also responsible for the management of the funds and the justification of the used finances to the Belgian Government on a three-monthly basis (Technical Comity).*

*As described, based on commercial contracts between NIRAS-ONDRAF and Belgoprocess, as the responsible operator of the installations, decommissioning works are ordered and has to be executed according to those stipulated conditions.*

Is insurance available and used to cover financial risks?

No.

### **Special cases: Fall-back option and transfer of ownership**

Please answer the following questions:

*The fact that all decommissioning activities in installations making part of the nuclear passive of Belgoprocess are financed by the Belgian Government on a yearly basis, has as a consequence that all questions below are not applicable to the situation of Belgoprocess.*

What happens in case of early shut down of the nuclear facility? Who is responsible for the provision for decommissioning in this case and in the case the operator is not able to financially provide for total costs of decommissioning? (fall-back option)

What happens to liabilities, responsibilities and funds in case of transfer of ownership?

Is there any protection of funds in case of insolvency of funds manager or operator of the facility?

Table 11 Base for decommissioning funds required

Short name of nuclear facility grouping for types of facilities possible	Kind of facility: NPP = nuclear power plant Others: please specify	Please check if decommissioning funds are based on overnight / undiscounted decommissioning costs	Please check if decommissioning funds are based on net present value / discounted decommissioning costs	Discount rate used for discounting, if any	Reference date used for discounting	Remarks
not applicable to the financing of the decommissioning of the nuclear passive of Belgoprocess						

Source:



Table 12 Decommissioning funds accumulated in relation to expected total costs of future decommissioning of BELGOPROCESS's nuclear installations (in prices of 2004)

Short name of nuclear facility grouping for types of facilities possible	Kind of facility: NPP = nuclear power plant	Total decommissioning costs estimated [Mio. Euro]	Provisions accumulated by 31-12-2004 [Mio. Euro]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]	Remarks e.g. with regard to time horizons and interest rates used for calculation
not applicable to the financing of the decommissioning of the nuclear passive of Belgoprocess						

Source:

Table 13 Investment of decommissioning funds until they are used for their original purpose

Short name of nuclear facility grouping for types of facilities possible	Kind of facility: NPP = nuclear power plant	Provisions accumulated by 31-12-2004 [Mio. Euro]	... of which have been invested in secure state bonds [Mio. Euro]	... of which have been invested in other assets with fixed interest rates [Mio. Euro]	... of which have been lent to associated companies or to third parties [Mio. Euro]	... of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. Euro]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]	Remarks
not applicable to the financing of the decommissioning of the nuclear passive of Belgoprocess									

Source: